

Perform arithmetic operations on polynomials, extending beyond the quadratic polynomials (Standards A.APR.1). Standard A.APR.1: Understand that all polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	
Concepts and Skills to Master <ul style="list-style-type: none">• Add, subtract and multiply polynomials.• Understand closure of polynomials for addition, subtraction, and multiplication (for example, extend properties of arithmetic to polynomial arithmetic).	
Related Standards: Current Course III.N.CN.8 , III.A.SSE.1 , III.A.APR.2 , III.A.APR.3 , III.A.APR.4 , III.A.APR.5 , III.A.APR.6 , III.A.APR.7	Related Standards: Future Courses P.N.CN.3 , P.N.CN.5 , P.N.CN.10

Support for Teachers

Critical Background Knowledge <ul style="list-style-type: none">• Performing the mathematical operations of addition, subtraction, and multiplication using quadratics (II.A.APR.1)• Understanding closure of polynomials for addition, subtraction, and multiplication (II.A.APR.1)
Academic Vocabulary
closure
Resources

[Curriculum Resources](#): <https://www.uen.org/core/core.do?courseNum=5630#71594>

Understand the relationship between zeros and factors of polynomials (Standards A.APR.2-3). Standard A.APR.2: Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x-a$ is $p(a)$, so $p(a) = 0$ if and only if $(x-a)$ is a factor of $p(x)$.	
Concepts and Skills to Master <ul style="list-style-type: none">• Understand that if $p(a) = 0$ then $(x - a)$ is a factor of $p(x)$.• Understand that if $(x - a)$ is a factor of $p(x)$ then $p(a) = 0$• Use the Remainder Theorem to determine zeros and factors of polynomials.• Explain the relationship between the quotient and the remainder for polynomial division problems.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.APR.1 , III.A.APR.3 , III.A.APR.6 , III.N.CN.9 , II.A.SSE.1 , III.A.SSE.2 , III.A.CED.1 , III.F.IF.4 , III.F.IF.7 , III.F.IF.8	P.F.IF.7

Support for Teachers

Critical Background Knowledge (Access background knowledge)
<ul style="list-style-type: none">• Solve quadratic equations (II.N.CN.7, II.N.CN.8, II.N.CN.9)• Factoring a quadratic expression to reveal the zeros of the function it defines (II.A.SSE.3, II.F.IF.8)
Academic Vocabulary
Remainder Theorem
Resources
Curriculum Resources : https://www.uen.org/core/core.do?courseNum=5630#71596

<p>Understand the relationship between zeros and factors of polynomials (Standards A.APR.2-3).</p> <p>Standard A.APR.3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.</p>	
<p>Concepts and Skills to Master</p> <ul style="list-style-type: none">Given a polynomial function in factored form, identify and use the zeros and other key features to make a sketch of the graph of the function.Recognize that repeated factors indicate multiplicity of roots and understand how they impact the graph.	
Related Standards: Current Course	Related Standards: Future Courses
III.A.APR.2 , III.A.SSE.1 , III.A.SSE.2 , III.A.CED.1 , III.N.CN.9 , III.F.IF.4 , III.F.IF.7.c , III.F.IF.8	P.F.IF.7

Support for Teachers

Critical Background Knowledge
<ul style="list-style-type: none">Graphing quadratic functions by hand, showing intercepts, and maxima or minima (II.F.IF.7)
Academic Vocabulary
Resources

[Curriculum Resources](#): <https://www.uen.org/core/core.do?courseNum=5630#71597>

Use polynomial identities to solve problems (Standards A.APR.4-5).

Standard A.APR.4: Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

Concepts and Skills to Master

- Prove polynomial identities that expand or factor polynomials.
- Use structure to show the relationship between two related polynomial expressions.

Related Standards: Current Course

[III.A.SSE.1](#), [III.A.SSE.2](#), [III.N.CN.8](#), [III.F.IF.8](#)

Related Standards: Future Courses

[P.F.TF.9](#)

Support for Teachers

Critical Background Knowledge

- Use the structure of an expression to rewrite it ([II.A.SSE.2](#), [II.A.SSE.3](#), [II.F.IF.8](#))

Academic Vocabulary

polynomial identity

Resources

[Curriculum Resources](#): <https://www.uen.org/core/core.do?courseNum=5630#71599>

Use polynomial identities to solve problems (Standards A.APR.4-5).

Standard A.APR.5: Know and apply the Binomial Theorem for the expansion of $(x+y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers. *For example, with coefficients determined by Pascal's Triangle.*

Concepts and Skills to Master

- Find terms for an expanded product using the Binomial Theorem, recognizing how Pascal's Triangle can be useful in the expansion

Related Standards: Current Course

[III.A.SSE.1](#), [III.A.SSE.2](#), [III.F.IF.8](#)

Related Standards: Future Courses

[P.S.CP.9](#)

Support for Teachers

Critical Background Knowledge

- Use the structure of an expression to rewrite it ([II.A.SSE.2](#), [II.A.SSE.3](#), [II.F.IF.8](#))

Academic Vocabulary

Binomial Theorem, Pascal's Triangle

Resources

[Curriculum Resources](https://www.uen.org/core/core.do?courseNum=5630#71600): <https://www.uen.org/core/core.do?courseNum=5630#71600>

Rewrite rational expressions (Standards A.APR.6-7).

Standard A.APR.6: Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division or, for the more complicated examples, a computer algebra system.

Concepts and Skills to Master

- Gain procedural fluency and conceptual understanding of how and why to rewrite rational expressions as quotients and remainders.
- Rewrite simple rational expressions using inspection, long division and computer algebra system to divide complicated polynomials.

Related Standards: Current Course

[III.A.SSE.1](#), [III.A.SSE.2](#), [III.A.APR.2](#), [III.A.APR.7](#), [III.F.IF.7d](#), [III.F.IF.8](#)

Related Standards: Future Courses

[P.F.IF.7](#)

Support for Teachers

Critical Background Knowledge

- Multiplying/adding/subtracting polynomials ([II.A.APR.1](#))
- Find whole number quotients and remainders ([4.NBT.6](#))

Academic Vocabulary

rational expression, computer algebra system

Resources

[Curriculum Resources](#): <https://www.uen.org/core/core.do?courseNum=5630#71602>

Rewrite rational expressions (Standards A.APR.6-7).

Standard A.APR.7: Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Concepts and Skills to Master

- Add, subtract, multiply, and divide rational expressions.
- Understand that rational expressions are closed under addition, subtraction, multiplication, and non-zero division.
- Relate rational number arithmetic to rational expression arithmetic and become fluent with the latter.

Related Standards: Current Course

[III.A.SSE.1](#), [III.A.SSE.2](#), [III.A.APR.1](#), [III.A.APR.2](#), [III.A.APR.6](#), [III.F.IF.8](#)

Related Standards: Future Courses

Support for Teachers

Critical Background Knowledge

- Understand operations with rational numbers ([7.NS.1](#), [7.NS.2](#)) and the closure property ([II.N.RN.3](#))
- Closure of polynomials ([II.A.APR.1](#))

Academic Vocabulary

rational expression, computer algebra system

Resources

[Curriculum Resources](#): <https://www.uen.org/core/core.do?courseNum=5630#71603>